REVISED

U. S. DEPARTMENT OF AGRICULTURE

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THE DISINFECTION OF STABLES

Rev. ed. follows

THE WORK of the Bureau of Animal Industry in dealing with infectious diseases of livestock has shown that the average stockman and farmer does not sufficiently realize the importance of thoroughly disinfecting his premises following an outbreak of contagious disease.

Minute organisms—germs—of various kinds have been identified by the microscope as the direct cause of many diseases of animals. Unless destroyed these germs have the power to maintain themselves on premises for indefinite periods. So long as they thus remain they are a constant menace and may at any time be the cause of an outbreak.

Proper disinfection destroys disease germs. There is, however, much lack of information concerning the destructive powers of the various disinfectants and the best and most economical ways of using them.

Thoroughness in doing the work is most important. Careless disinfection is little better than none at all, because it does not insure against future trouble.

This bulletin describes some of the more reliable disinfecting agents, together with approved methods of their application.

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THE DISINFECTION OF STABLES

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THE NECESSITY FOR DISINFECTION

SCIENCE, by means of the high-power microscope, has confirmed the existence of numerous minute animal and vegetable organisms far too small to be seen with the unaided eye. It is a matter of common knowledge that many of these organisms frequently find their way into the animal body and produce disease. It is also well known that these micro-organisms, or germs, vary in form and other characteristics and that for each disease of an infectious nature there is a specific germ.

If these germs could be confined to the animal body and die with it there would be no such thing as an infectious disease. Unfortunately, however, they are thrown off by the animal through the excretions and lie in the soil, in the litter of stables, on the floor and walls, and in cracks and crevices. Here they may remain and maintain their virulence for an indefinite period, ready at any time to be gathered up by an animal in its feed or to be blown about in dust and drawn into the lungs or to gain access to the body through wounds.

For example, we have tuberculosis in cattle and glanders in the horse. In the former disease the causative agent is a rod-shaped germ (*Mycobacterium tuberculosis*) which averages about 0.0001 inch in length. Cattle affected with tuberculosis pass myriads of these germs with the manure, and it is not difficult to understand how in the average stable they would have little difficulty in finding many lodging places.

In glanders the causative agent is another rod-shaped germ (*Pfeifferella mallei*), about the same length as the tuberculosis germ, but somewhat thicker. A characteristic of this disease is the formation of ulcers in the nostrils and other portions of the body, from which there is more or less discharge laden with the glanders germ. And here, again, it is not difficult to understand how one diseased animal may contaminate extensive premises.

Blackleg in young cattle and tetanus or lockjaw affecting various animals, more particularly horses, both exceedingly fatal affections, are examples of disease caused by minute organisms which find entrance into the body through wounds, not, however, directly from one animal to another but as a result of the victim's coming in contact with contaminated soil, manure, or other materials on infected premises.

As has been stated, some of these minute forms are vegetable organisms. In fact, these vegetable parasites are the cause of some of the most destructive diseases, and some of them are very difficult to destroy, as they contain spores. A spore may be likened to the seed of a plant, for it bears about the same relation to the microorganism (bacterium) that a grain of wheat does to the plant

FIGURE 1.—A stable and yard that are very difficult to clean and disinfect.

proper. As the plant may be destroyed and the seed remain latent for an indefinite time, so destruction of the bacterium may be accomplished while the spores remain unharmed and retain life for weeks, months, or years.

An example of this class of organisms is seen in the agent which causes anthrax (*Bacillus anthracis*). Ordinary methods for the destruction of the bacterium will not destroy the spore as well, and thus anthrax becomes a most difficult disease to eradicate. On farms where animals have died from anthrax and the carcasses have been buried instead of being destroyed, repeated outbreaks of the disease may occur from time to time, possibly extending over a period of several years. This condition is due to the existence of the very resistant spores, which, under favorable circumstances, are carried to the surface of the earth and become infecting organisms—much as the seed of a noxious weed, after remaining in the soil during the winter, finds the conditions favorable in the spring and develops into a

plant—except that these minute forms of life multiply with the most wonderful rapidity.

Then there are a few communicable diseases which are caused by so-called "viruses." In such cases the organism or causative agent is apparently so minute as to be invisible under the highest powered microscope or to escape through the finest filter available to bacteriologists. Among these diseases are hog cholera, foot-and-mouth disease, and fowl pest. Fortunately these ultramicroscopical organisms or filtrable viruses are readily destroyed by proper disinfectants.

There are also certain diseases caused by small animal parasites which make necessary a careful cleansing of pens and buildings. Among these parasites are various species of mange mites which cause mange or scabies in horses, cattle, sheep, swine, and dogs. These are not truly microscopic in size, but are too small to be seen without the aid of a magnifying glass except by a person with keen eyesight and are entirely different in character from the germs or infecting organisms previously described. Although the mange mite lives on the skin, any corrals, pens, chutes, and sheds which have contained affected animals are likely to become infected and require cleaning and disinfection.

The importance of proper disinfection should not be overlooked where efforts are being made to free animals from internal parasites. Stomach worms and other worms in sheep and roundworms in swine cause heavy losses to breeders and feeders. Premises contaminated with the eggs of such undesirable foes to thrift should receive attention in any campaign designed to prevent young animals in the flock or herd from becoming infested.

Against parasites the ordinary disinfectants used to destroy the germs of bacterial diseases are of little value in themselves. Destruction of the infective stages of the various kinds of parasites that have been mentioned depends largely on thorough cleansing, including removal of all litter, contaminated soil, manure, etc., the liberal use of scalding water and other means of securing cleanliness. Disinfecting solutions alone do little good, and special attention must be given to cleaning and disinfecting premises when parasitic diseases are involved, or disappointing results are likely to follow.

THE NATURE OF DISINFECTION

The work of disinfection is based on our recognition of the presence of disease germs, and disinfection means the act of destroying the cause of the infection. In other words, disinfection is a removal of the cause, and it will be clear that in dealing with disease any effort which stops short of a complete removal of the cause is most unwise and unprofitable. To those unaccustomed to the work, disinfection may seem a most complicated process. Any approved method, however, is comparatively simple when carried out carefully, although, like many another procedure, it is one in which attention to details counts for much. It is important to bear in mind that the causative agents of many diseases are extremely small and may remain for an indefinite time in dust, cracks, and crevices of buildings, so that efforts aiming at the eradication of disease from contaminated premises must be thorough in order to be effective.

Stables of the kinds shown in figures 1 and 2 are very difficult to disinfect. On the other hand, a sanitary stable of the type shown in figure 3 may be thoroughly disinfected with comparative ease.

DISINFECTANTS

In the work of disinfection nature has provided man with a most valuable ally—sunlight. It is well known that the direct rays of the sun are inimical to many forms of bacteria, in some cases destroying them and in others lessening their influence. Thus the importance of well-lighted stables is evident. The dark and sunless building is a favorable harboring place for bacteria, and the structure which admits the greatest amount of sunlight is the least favorable for their development. Again, heat will destroy the bacteria of

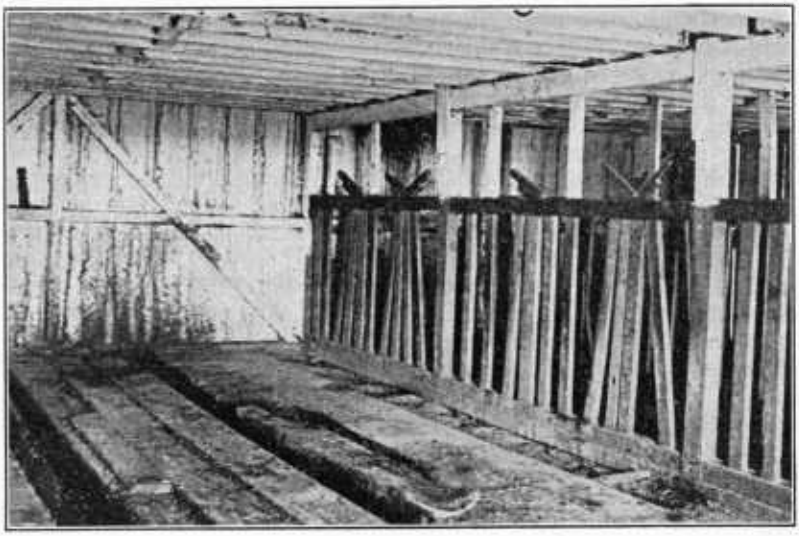

FIGURE 2.—Interior of a stable where disease germs find ready lodgment and are hard to reach and destroy. Before disinfection a thorough cleaning would be necessary, involving the removal and burning of some of the woodwork.

disease. By this is not meant the ordinary heat of the sun, but heat as developed in boiling water or in flame. It is on this principle that the surgeon before operating renders his instruments free from the possible presence of bacteria by moist or dry heat, and it is the heat in a jet of steam which renders it destructive to bacteria. Sunlight, however, cannot be considered more than an accessory in the destruction of bacteria, while the application of heat in the form of steam is seldom possible and the use of a flame torch is not safe in the average building. Consequently, in the practical work of disinfection we are dependent upon certain drugs which have power to destroy the organisms of disease.

These chemicals are known as disinfectants, and, fortunately, there are available a number that possess the power of destroying bacteria. It is not the purpose here to discuss the exact manner in which they act. It is sufficient to know that when properly selected and applied they possess the power of destroying bacterial life with the same cer-

tainty with which poisonous chemicals destroy animal life. As disinfectants differ in potency and in their adaptability to general use, they each possess certain advantages as well as disadvantages.[1] A few of the common disinfectants are described briefly herewith.

BICHLORIDE OF MERCURY

Bichloride of mercury, known as "corrosive sublimate" and as "mercuric chloride", is used in a solution in water, commonly in a strength of 1 to 1,000, though solutions of double that strength may be employed. Although possessing great germicidal power, it has the disadvantages of being a violent poison, of corroding metals, and of uniting with albuminous substances, such as excreta, blood,

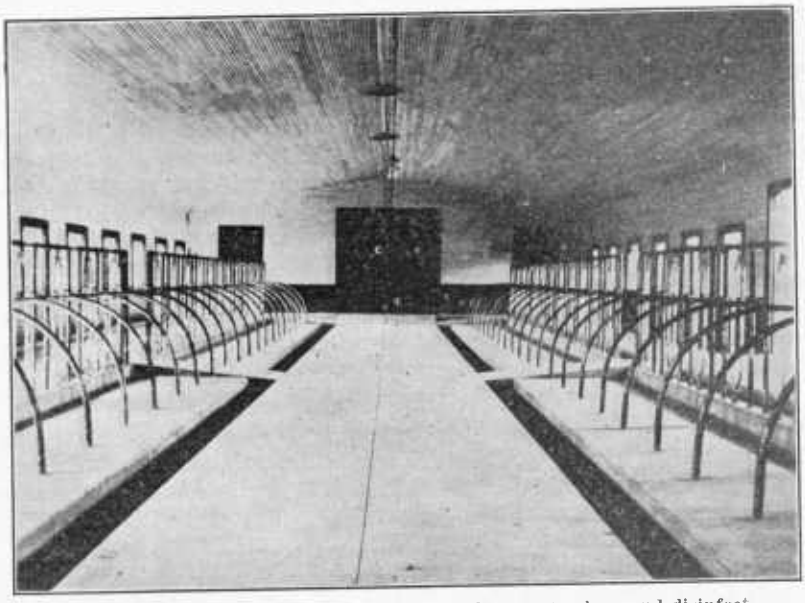

FIGURE 3.—A sanitary stable that is relatively easy to clean and disinfect.

etc., and thus forming inert compounds. Unlike the coal-tar products, it leaves no odor in the stable, which is an advantage in connection with the production of milk. On the other hand a solution of this chemical is poisonous to animals and to man and its use for general stable disinfection is questionable. If used, it should be handled with the utmost care, and feed boxes to which it has been applied should be washed with clear water before animals again have access to them.

CHLORIDE OF LIME

Chloride of lime (chlorinated lime) is a well-known disinfectant, although its value is doubtless greatly overrated. This may be due in part to the fact that it is a powerful deodorant—such products on account of their pungent odor being popularly believed to have

[1] For fuller details regarding disinfecting agents the reader is referred to Farmers' Bulletin 926, Some Common Disinfectants, from which some of the information herein given has been derived.

great disinfecting power. Being of uncertain strength and somewhat destructive to metals and having a permeating odor, especially objectionable in a stable where milk is produced, chloride of lime cannot be classed as the most desirable of disinfectants. For general disinfecting purposes it may be mixed with water in the proportion of 6 ounces to the gallon.

CHLORINE GAS

Chlorine gas, which has long been used in the purification of city water supplies and swimming pools and the disinfection of tannery effluents, has more recently been applied in the treatment of infectious respiratory conditions in both man and animals. This has led to a popular belief that it may be a satisfactory disinfectant for general use. Experiments were at one time conducted by officers of the Veterinary Corps, Medical Department, United States Army, in the control of an outbreak of influenza. Many affected and exposed Army horses in this instance were subjected to the fumes of chlorine in a closed stable with what were considered to be favorable results. The practical value of such treatment, however, has not been generally established. As chlorine gas has marked disinfecting properties, there may be special cases in which it can be utilized in the disinfection of stables. The fact, however, that chlorine lacks penetrating power or becomes more or less inert in the presence of organic matter, and the highly corrosive action of the chemical on metals, tend to limit its sphere of usefulness and render general application as a stable disinfectant problematical if not impracticable.

LYE

Ordinary lye, or caustic soda, through its content of sodium hydroxide, is highly effective as a disinfectant against the microorganisms that cause fowl cholera, bacillary white diarrhea of young chicks, typhoid fever in man, and also foot-and-mouth disease in countries where it exists.

Lye has certain disadvantages which should not be overlooked. It is not effective against the germs of tuberculosis. In concentrated form it is a caustic poison. Livestock should be prevented from access to lye or to solutions of it. Those who handle lye should not forget that serious results may follow breathing the dust or the introduction of any of the solution into the eyes. The caustic properties of lye cause injury to painted or varnished surfaces, fabrics, etc. These are characteristics which should not be overlooked when considering its use as a disinfectant.

LIME

Milk of lime or limewash is frequently used as a disinfectant. The lack of odor and the availability and cheapness of lime contribute to its usefulness, especially in dairy barns. It has limitations as a disinfectant, however, and will not prove efficient against diseases caused by resistant spore-producing organisms such as anthrax, or against tuberculosis.

In preparing limewash, quicklime should be used and by the addition of water converted into the hydrate of lime commonly termed

water-slaked lime. Air-slaked lime or quicklime that has been exposed to the air for a long period is practically worthless as a disinfectant. Methods of preparing a limewash are more fully described in the section of this bulletin on selection and preparation of the disinfectant.

FORMALDEHYDE

An aqueous solution containing approximately 40 percent of formaldehyde has in recent years become a more or less popular disinfectant. Formaldehyde is used in either liquid or gaseous form. In the former a 40 percent solution is mixed with water in the proportion of 6 ounces to the gallon, and the resulting solution is applied directly to surfaces or substances which are to be disinfected.

Formaldehyde gas is in most cases impracticable for stable disinfection. Where, however, a stable can be made almost airtight, and the animals removed, it is very serviceable, as it penetrates every crevice.

Several methods are used in disinfecting with formaldehyde gas. Probably one of the most practicable is to liberate the gas by means of the chemical reaction which takes place when a formaldehyde solution is poured upon permanganate of potassium. For each 1,000 cubic feet of air space 16⅔ ounces of crystallized or powdered permanganate of potassium is placed in a wide pan; 20 ounces of a 40-percent formaldehyde solution is then poured upon it and the room immediately closed for 12 hours or longer. This method is efficient only when it is possible to seal tightly the rooms or compartments to be disinfected and when their temperature is not below 50° F.

CARBOLIC ACID

Carbolic acid in its pure form, at ordinary temperatures, is in the shape of long, white crystals. For convenience it is frequently dispensed in liquid form by the addition of 10 percent of water. A 5-percent solution of carbolic acid is sometimes used as a disinfectant, but carbolic acid has the disadvantage of being expensive and somewhat difficult to dissolve.

COMPOUND SOLUTION OF CRESOL

Compound solution of cresol (liquor cresolis compositus), now recognized by the United States Pharmacopoeia as an official preparation, is composed of equal parts of cresol (U.S.P.) and linseed-oil-potash soap. In a 3- to 4-percent solution it is an efficient disinfectant against all ordinary diseases and has the advantage of mixing readily with water. The chief objection to its use, however, is the strong odor which it is likely to impart to food products such as milk. This greatly affects its usefulness in dairy barns, etc.

Saponified cresol solution as prepared by various manufacturers is sometimes used as a substitute for compound solution of cresol (U.S.P.).

Under regulations of the Department of Agriculture only such preparations of saponified cresol solution as meet certain requirements are permitted for official disinfection of cars, boats, other vehicles, premises, etc. A list of such permitted disinfectants is furnished by the Bureau of Animal Industry, Washington, D.C., on request.

SODIUM ORTHOPHENYLPHENATE

A substance known as sodium orthophenylphenate has proved to be a valuable disinfectant and, like compound solution of cresol, is effective against the germs of tuberculosis. It has an advantage over saponified cresol solution in being free from objectionable odor. It is readily soluble in water and is in the form of grayish, brownish, or white powder which must necessarily be kept in a close container in order to prevent deterioration. It is not highly poisonous. As the solution is not effective at a low temperature, it becomes necessary to apply it hot in order to insure satisfactory results. Sodium orthophenylphenate preparations under specific named brands are permitted in official disinfection in tuberculosis-eradication work.

DETAILS OF DISINFECTION

In the practical work of disinfection there are three essentials:

(1) A preparation of the building that will facilitate reaching organisms of disease.

(2) A disinfectant which upon contact can be depended on to destroy such organisms.

(3) A method of applying the disinfectant that will assure the most thorough contact with the bacteria.

PREPARATION OF BUILDING

Before beginning the use of a disinfectant it is essential that certain preliminary work be done in and about the stable that is to be treated. The various surfaces, such as ceiling, walls, partitions, floors, etc., should be swept free of cobwebs and dust. Any accumulation of filth should be removed by scraping and scrubbing with a wire or other stiff brush and warm water with a liberal quantity of washing soda. In some cases the woodwork may have become softened and so porous as to be a good medium for the absorption of disease germs. Such woodwork should be removed, burned, and replaced with new material.

All refuse, manure, etc., from stable and barnyard should be removed to a place inaccessible to livestock and, if possible, should be burned or thoroughly mixed with a solution of chloride of lime in the proportion of 6 ounces to 1 gallon of water. A good method of cleaning gutters is shown in figure 4. If the floor is of earth, it will doubtless have become stained with urine and contaminated to a depth of several inches. In such cases 4 inches or more of the surface soil should be removed and treated as suggested above for refuse and manure. All earth removed should be replaced with soil from an uncontaminated source, or better, a new floor of concrete may be laid, this being the most durable and sanitary material for the purpose.

SELECTION AND PREPARATION OF THE DISINFECTANT

Having made ready the field of operation, the next consideration should be the selection and preparation of the disinfectant. The fact must not be overlooked that many agents used for destroying bacteria are likewise poisonous to animals and man. In fact, some

chemicals such as bichloride of mercury, previously mentioned, although powerful as germicides, are so poisonous as to preclude their general use in disinfection. Some that are highly efficient against the bacteria of one or more specific diseases are not effective in the case of other diseases. For these reasons it is essential to select a disinfectant that will meet the needs of each individual case, have the required effectiveness and properties of solubility, and at the same time provide a reasonable degree of safety to animals and man.

All things considered, it is probable that saponified cresol solution or a solution of sodium orthophenylphenate will fulfill these requirements better than any of the other disinfectants mentioned. Saponified cresol solution should be used in the proportion of at least 4 ounces to each gallon of water. Sodium orthophenylphenate should be added to water in the proportion of 1 pound to 12 gallons of water. A solution of this kind will be found highly desirable for disinfecting infected premises following the removal of cattle that have reacted to the tuberculin test. This solution must be applied hot.

FIGURE 4.—Removing manure from gutter preparatory to disinfecting.

Lye is highly effective as a disinfectant against various diseases with the exception of tuberculosis. It is particularly valuable in cleaning poultry houses, and has the advantage of being inexpensive and odorless, but should not be used as a disinfectant for houses or stables infected with tuberculosis. Its caustic and poisonous characteristics as previously discussed should not be overlooked. A good grade of the commercial product containing not less than 94 percent sodium hydroxide should be used in the proportion of 1 pound to 5½ gallons of water. The lye selected for use should have previously been kept in a tight container. Five pounds of water-slacked lime added to each 5½ gallons of lye solution will form a whitewash. This will increase the efficiency of the lye and produce a mixture that is suitable for whitewashing surfaces having no painted areas, metals, or other materials which might be injured as a result of chemical action produced by the lye.

METHOD OF APPLICATION

The efficacy and economy of the work will depend in a great measure on the method of applying the disinfectant. Economy requires that the disinfecting solution be applied rapidly; efficiency requires not only that it be spread in such manner as to cover the

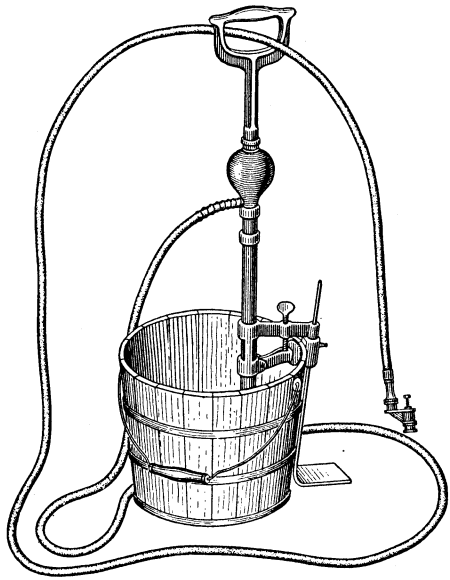

FIGURE 5.—Pail spray pump suitable for disinfecting small stables.

entire surface requiring disinfection, but that sufficient quantity and force be used to drive the solution into all cracks and crevices.

If a very limited surface is to be treated, as, for example, one stall, it may be possible to apply the disinfectant in a satisfactory manner by means of a whitewash brush. In all cases, however, the best method of applying the disinfectant and the limewash is by means of a strong spray pump. Such a pump should be equipped with not less than 15 feet of hose, to which may be attached a 5-foot section of iron pipe of the same caliber as the hose. With a spraying nozzle at the end of the pipe, the operator will be able to work with the greatest possible dispatch and the least possible inconvenience. Good types of hand-operated apparatus are shown in figures 5, 6, 7, and 8. Figure 9 shows an outfit in use by two men. Figure 10 illustrates power equipment.

The entire interior of the stable should be saturated with the disinfectant. Special attention should be given to the feeding troughs and drains. After the disinfectant has dried, the surface may be sprayed with limewash, provided this is desired. When the work has been completed it will be advisable to open all doors and windows of the building to admit air and light.

The metal parts of any pump or other equipment used in spraying disinfectants, especially a lye solution, should be carefully cleaned and oiled following use.

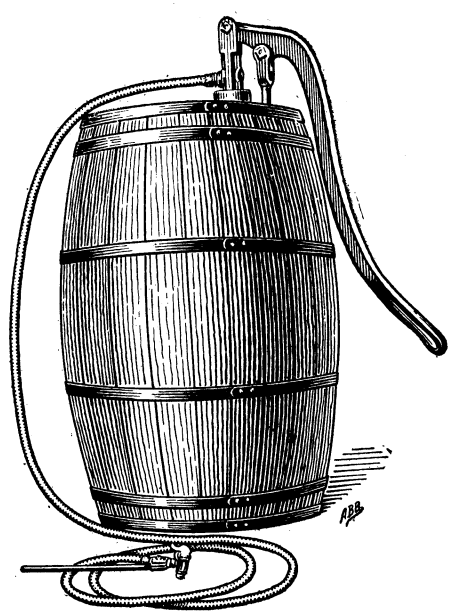

FIGURE 6.—A good type of barrel sprayer.

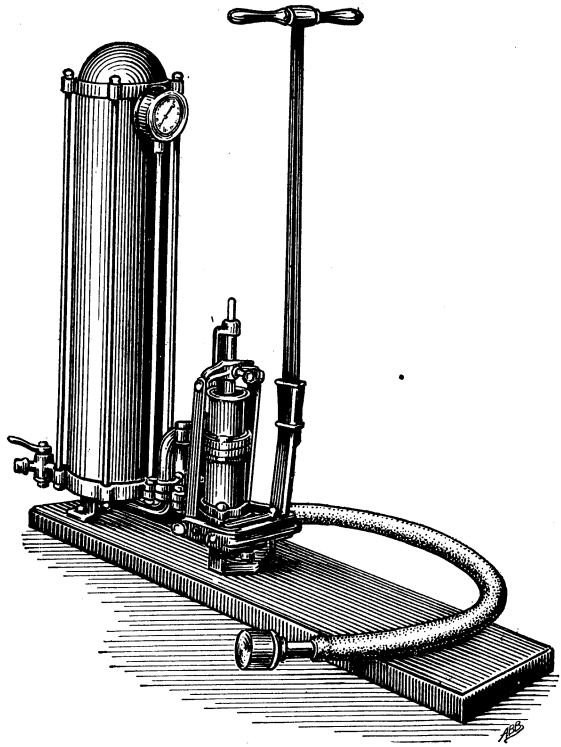

FIGURE 7.—A double-acting sprayer, with air chamber.

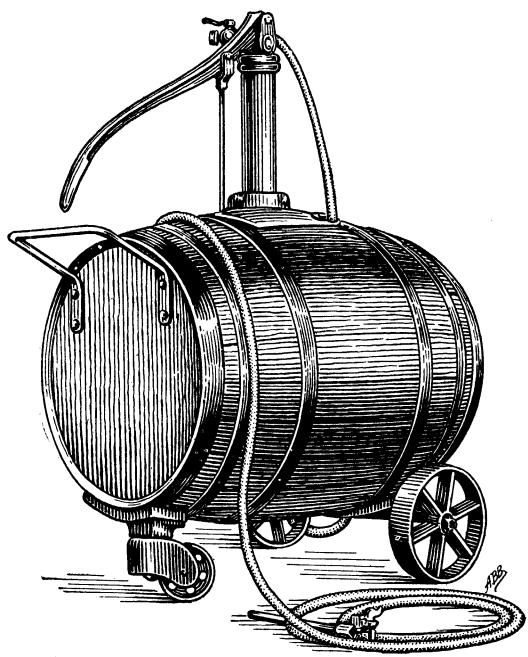

FIGURE 8.—A whitewashing outfit.

FIGURE 9.—Where disinfection is a 2-man job.

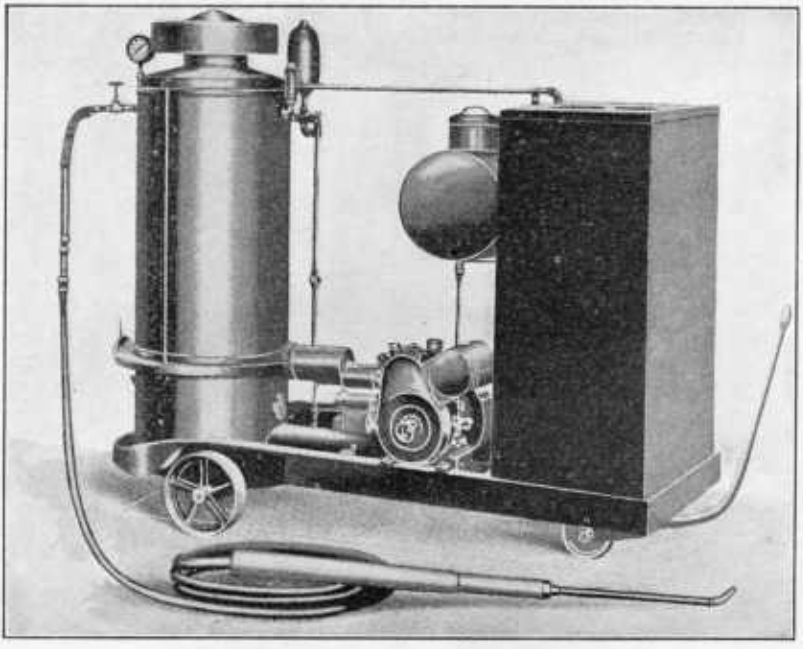

FIGURE 10.—A power equipment suitable for extensive disinfecting. It contains an oil-burning device for heating the disinfectant and a motor for compressing air to operate the spray.

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